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Materiel Test Procedure 4-3-119
U. S. Army Field Artillery Board

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY SERVICE TEST PROCEDURE

PROJECTILE, "BEEHIVE"

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1. OBJECTIVE

The objective of this MTP is to describe the tests required to determine the suitability of a "beehive" type projectile for artillery use as specified in the Qualitative Materiel Requirements (QMR) or Small Development Requirement (SDR).

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2. BACKGROUND

The "beehive" projectile is a rather highly sophisticated type of ammunition designed for special use. Its payload consists of thousands of small flechetts or metal arrows that are distributed over the target area with lethal penetrating velocity. The "beehive" projectile has three primary uses or modes of firing:

- a. Muzzle action where the flechetts are discharged directly from the tube.
- b. Direct fire time action where the time fuze is set for action shortly after leaving the tube.
- c. Indirect fire when the fuze is set to detonate the round at a predetermined height above the target.

This MTP will discuss the tests used for all three methods of use.

3. REQUIRED EQUIPMENT

- a. Howitzer/Gun of Appropriate Caliber.
- b. Standard Ammunition Components compatible with test projectile.
- c. Direct and Indirect Firing Ranges.
- d. Appropriate Standard Ammunition, for comparative firings, as required.
- e. Organizational and Direct Support Maintenance Facilities.
- f. Appropriate Firing Tables.
- g. Weapon Section Equipment.
- h. Burst Time Indicator.
- i. Communication Equipment, as required.
- j. Firing Direction Equipment and Operating Personnel.
- k. Meteorological Equipment.
- l. Ambulance and Aidmen.
- m. Flash Observation Posts and Personnel.
- n. Boresighting Devices.

4. REFERENCES

- A. Army Regulation 385-63, Safety Regulations for Firing Ammunition
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~~(AMSTTE-TS)~~, Aberdeen Proving Ground, Md 21005

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for Training, Target Practice, and Combat.

- B. Post (or Test Site) Range Regulations.
- C. USAMC Regulation 385-12, Verification of Safety of Materiel from Development through Testing, Production, and Supply to Disposition.
- D. USAMC Regulation 385-24, Range Safety.
- E. USAMC Regulation 385-224, AMC Safety Manual.
- F. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- G. FM 6-40, Field Artillery Cannon Gunnery.
- H. FM 9-1300-203, Artillery Ammunition.
- I. MTP 3-3-506, Accuracy and Precision.
- J. MTP 4-3-500, Preoperational Inspection and Physical Characteristics.
- K. MTP 4-3-501, Personnel Training.
- L. MTP 4-3-502, Ammunition Functioning and Reliability.
- M. MTP 4-3-504, User Reaction.
- N. MTP 4-3-506, Adverse Conditions.
- O. MTP 4-3-511, Transportability (Ammunition).
- P. MTP 4-3-513, Maintenance.
- Q. MTP 4-3-514, Safety Hazards.
- R. MTP 4-3-515, Human Factors Engineering.
- S. MTP 4-3-520, Field Storage.
- T. MTP 4-3-521, Training Manuals and Technical Publications.

5. SCOPE

5.1 SUMMARY

This document outlines procedures for service testing of "beehive" type projectiles in order to evaluate their suitability for use by the Army. The evaluation includes:

- a. Preparation for Test - A determination of the condition of the test item upon arrival, its physical characteristics, the availability of facilities, test item maintenance package, and all other support requirements, personnel training procedures and safety aspects of the test item.
- b. Component Compatibility - A study to determine the compatibility of the test item with "standard" ammunition components of the appropriate size.
- c. Accuracy and Precision and Ballistic Match - A study to determine the accuracy and precision of the test item, how it compares with a standard "beehive" type projectile, and the effects of field storage and transport on the test items accuracy and precision.
- d. Direct Fire Muzzle Action - A study to determine the acceptability of the test item in the direct fire muzzle action mode.
- e. Direct Fire Time Action - A study to determine the acceptability of the test item in the direct fire time fuze mode.
- f. Indirect Fire - A study to determine the effect of indirect fire of the test item on various targets.
- g. Adverse Conditions - A study to determine the effect of adverse environmental conditions on the test item effectiveness.
- h. Fire Direction Techniques - A study to determine if new fire direction techniques are required for effective use of the test item.

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- i. User Reaction - A determination of the reaction of personnel to the use of the test item.
- j. Ammunition Functioning Reliability - A study to evaluate the reliability of rounds using the test item.
- k. Maintenance Evaluation - A study to determine the maintainability of the test item and an evaluation of the test item maintenance package.
- l. Human Factors Evaluation - A study to determine the effectiveness of the test item-weapon-crew relationship.
- m. Safety Hazards - A study to determine test item-related safety hazards.

5.2 LIMITATIONS

None

6. PROCEDURES

6.1 PREPARATION FOR TEST

6.1.1 Preoperational Inspection and Physical Characteristics

Upon arrival, determine and record the physical characteristics and operational condition of the test item by subjecting them to the applicable sections of MTP 4-3-500.

6.1.2 Personnel

a. Ensure the availability of service personnel who have been trained using the criteria of MTP 4-3-501 in conjunction with the appropriate technical publications and training manuals of MTP 4-3-521 and are cognizant of the handling, assembling, maintaining, loading and firing, and safety hazard aspects of ammunition and ammunition components and the object of the procedure.

- b. Record the adequacy of the supplied training literature.
- c. Record the following for all test personnel:

- 1) Rank
- 2) MOS
- 3) Experience in MOS
- 4) Training time in MOS

6.1.3 Weapons

a. Ensure the availability of howitzers/guns of the appropriate caliber and tube model(s) which have had average use and which preferably have two-thirds of their tube life remaining.

- b. Record the type, caliber and model number of each weapon used.
- c. Determine and record the physical condition of each weapon used as indicated by visual inspection, borescoping, and tube wear measurements as indicated by a pull-over gauge.

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6.1.4 Ammunition and Ammunition Components

- a. Ensure the availability of sufficient standard ammunition components and standard ammunition to allow for comparative firings, as required.
- b. Prior to testing, subject a minimum of 30 test items which have successfully passed the initial inspection procedures of paragraph 6.1.1 to the field storage conditions of MTP 4-3-520 for 90 days.
- c. Prior to testing, subject a minimum of 30 test items which have successfully passed the initial inspection procedures of paragraph 6.1.1 to cross-country vehicle transportation tests as described in paragraph 6.2.2.3 below.

6.1.5 Firing Ranges and Targets

- a. Schedule the following type firing ranges:
 - 1) Indirect firing range which shall meet the requirements of MTP 3-3-506 as concerns range, flash observation posts and impact points.
 - 2) Target effects field, for tests involving lethality and determinations containing flash observation posts if impact burst indicators are not available.
- b. Prepare targets constructed of layers of fiberboard so that depth of penetration can be measured during lethality determination tests.

6.1.6 Safety

The test officer will review the Safety Release to identify any safety limitations required during conduct of the test.

6.2 TEST CONDUCT

NOTE:

1. Normally, when testing ammunition components, only limited quantities of the test item is available, as such all test personnel shall be acquainted with the necessity of accurately gathering maximum data for each round fired. As such, subtests shall be conducted concurrently with, or in conjunction with, other subtests, whenever possible.
2. The projectile undergoing test will normally have the capability of being fired from several different models of tubes. For complete and valid testing, the test item must be fired with all models of tubes specified in the QMR's and TC's. This will necessitate repetition of each of the subtests listed below:

Record the current meteorological data just prior to the start of firing, and at least every two hours thereafter, during testing.

6.2.1 Component Capability

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a. Prior to firing assemble complete rounds in such number as to equal the number of different fuzes in combination with the test item and record evidence of incompatibility of the test item with the following:

- 1) Propellant charge (including cartridge case when applicable)
- 2) Fuze assembled to the test item

b. Disassemble the items of step a and return them to their packaging.

c. During all firing procedures record any difficulty encountered in setting the fuze on the test round.

6.2.2. Accuracy and Precision and Ballistic Match

NOTE: 1. Accuracy and precision firings will vary slightly from the procedures in MTP 3-3-506. The ten round groups will be fired with the same weapon settings at a point in the air saving ammunition in that probable errors in range, deflection and height of bursts may be determined from each ten round group.

2. Ballistic match will have been achieved if the center of comparative groups are within the allowable range, deflection and height of burst probably errors of each other as set forth in the requirements document, and they have comparable dispersion patterns. Under these conditions the test projectiles, assembled with standard components, are considered to "shoot" the same as the standard projectiles and are, therefore, suitably accurate.

6.2.2.1 Comparison Firings

a. Assemble a sufficient number of test rounds consisting of standard components with test projectiles to meet the minimum requirements of the applicable sections of MTP 3-3-506.

b. Assemble "standard rounds" using all standard components and projectiles equal in number to the rounds of step a.

c. Fire alternately the test rounds and standard rounds and determine the location of impact for each as described in the applicable sections of MTP 3-3-506 and record the following:

- 1) Data, as required, in the applicable sections of MTP 3-3-506
- 2) Type, caliber, and model number of each weapon used
- 3) Propellant charge used

d. For test rounds equipped with a pyrotechnic flare for forward observer adjustment, locate and record the point of impact of the flare with respect to the pattern of effect on the ground.

NOTE: The pyrotechnic flare should impact in the approximate center of the pattern of effect.

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6.2.2.2 Field Storage

a. Determine the effects of field storage, as described in paragraph 6.1.4.b above and record the applicable storage and inspection data of MTP 4-3-520.

b. At the completion of step a above subject the stored test items and an equal number of non-stored test items to the applicable procedures of MTP 3-3-506 and record the date of paragraph 6.2.2.1.c.

6.2.2.3 Transportability

a. Subject the test items of paragraph 6.1.4.c using the criteria of MTP 4-3-511, to cross-country vehicle transportation tests using trailers, trucks, and self-propelled weapon storage racks, as applicable for a distance of 500 miles.

b. At the completion of each 100 miles of travel, unload the test items and record the following:

- 1) Type of vehicle used
- 2) Material handling equipment used
- 3) Damage sustained by the test item/test item container

c. At the completion of steps a and b above, determine the effects of transport on the accuracy and precision of the transported test items by subjecting them and an equal number of non-transported test items to the applicable firing procedures of MTP 3-3-506 and record the data of paragraph 6.2.2.1.c.

6.2.3 Direct Fire Muzzle Action

a. Emplace the appropriate weapon on the direct firing range.
b. Match all weapon indices and boresight the weapon.
c. Emplace fiberboard targets on an arc in front of the weapon at ranges of 50 and 100 meters (see Figure 1).

NOTE: 1. Assure that the 100 meter targets are offset or staggered from the targets on the 50 meter range.
2. Targets are to be so placed as to enable the determination of maximum left and right limits.

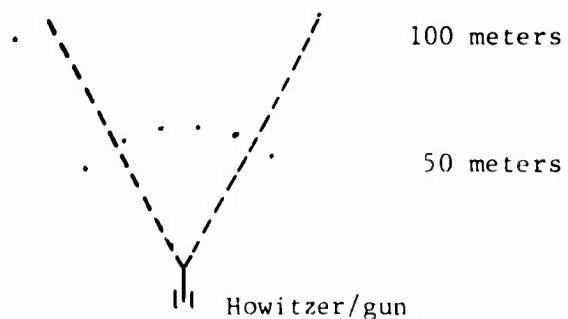


Figure 1. Target Arrangement

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d. Fire three rounds at 0 mil elevation and locate and record the point of functioning of each round using flash observation posts or a burst time indicator.

NOTE: Use maximum charge for all rounds.

e. Locate, count, measure and record the location and depth of each hit on each target.

f. Repeat steps c through e with the target ranges increased by 100 meters (150 and 200 meter ranges).

g. Repeat steps c through e with the target ranges increased 200 meters (250 and 300 meters) from the ranges of step c.

h. Repeat the procedures of steps c through e with the target ranges increased in increments of 100 meters, from the range of step c, until no hits are registered on the targets.

i. Repeat the procedures of steps c through h for weapon elevations of 10 mils and 20 mils.

j. Record details relative to any malfunction.

6.2.4 Direct Fire Time Action

a. Emplace the appropriate weapon on the direct firing range.
b. Match all weapon indices and boresight the weapon.

NOTE: The following procedures are described in principle only. The figures used are for example only. Exact fuze settings and elevations used for the various ranges will depend upon the requirements specified in the QMR or SDR.

c. Emplace fiberboard targets, as indicated in Figure 1, with the near range slightly greater than the range corresponding to fuze minimum time set.

d. Set the fuze to burst at minimum time.

e. Fire three rounds at 0 mil elevation and locate the point of functioning of each round using the burst time indicator.

NOTE: Use maximum charge for all rounds.

f. For rounds equipped with a dye marker record the following:

- 1) Visibility of the dye marker.
- 2) Location of point of functioning of each round using the dye marker.

g. Locate, count, measure and record the location and depth of each hit on each target.

h. Increase the range of the targets, from the distance of step c, in increments of 100 meters and repeat the procedures of steps d through g until no hits are registered on the targets.

i. Repeat the procedures of steps c through h with the fuze time set at increasing values, in appropriate increments until a fuze setting that gives an approximate range of 3000 meters.

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- j. Repeat steps c through i for weapon elevations as specified.
- k. Record details relative to any malfunctions.

6.2.5 Indirect Fire

6.2.5.1 Pyrotechnic Flare Marker

NOTE: This procedure shall be performed, using average trained observers, on test items having pyrotechnic flares for adjustment.

6.2.5.1.1 Normal Time Fire Adjustment - Perform the following:

a. Select firing position on the indirect firing range so that the following may be accomplished:

- 1) Three ranges can be fired per charge:
 - a) Short range (50 percent of maximum range)
 - b) Midrange (80 percent of maximum range)
 - c) Long range (100% of maximum range)
- 2) High angle fire can be performed at midrange for each charge

b. Perform a minimum of two "will adjust" missions at each condition, for all applicable charges, specified in step a and record the following:

NOTE: As a minimum the high, medium and low charges shall be used.

- 1) Difficulties experienced adjusting the round onto the target
- 2) Details relative to any malfunctions

6.2.5.1.2 Two-Phase Technique of Fire Adjustment - Perform the following when normal time fire is not feasible:

a. Select firing position as indicated in step a of paragraph 6.2.5.1.1.
b. Repeat the procedure of step b of paragraph 6.2.5.1.1 using the two-phase technique as follows:

- 1) Phase I: Adjust for range and deflection to get the flare on the approximate center of the target.
- 2) Phase II: Adjust the height of burst once the flare impacts the center of the target area.

6.2.5.2 Spotting Round

NOTE: This procedure shall be performed using average trained observers.

- a. Select firing position as indicated in step a of paragraph 6.2.5.1.1.
- b. Adjust spotting rounds on a target using minimum charge at short range.

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- c. Fire test rounds in fire for effect and perform the following:
 - 1) Inspect the impact area to determine compatibility of the test round and spotting round.
 - 2) Record the following:
 - a) Difficulties in adjusting onto target.
 - b) Large or significant dispersion between the spotting round and test round.
 - c) Details relative to malfunctions.

6.2.5.3 Transfer Fire

- a. Conduct a time registration using a ballistic match round at one extremity of transfer to determine corrections.
- b. Fire for effect with test round at the other extremity of transfer limits using the corrections obtained by registration (step a).
- c. Analyze target area effects for ballistic match round and test round compatibility.
- d. Record any difficulties encountered.
- e. Repeat the procedures of steps a through d a minimum of three times.

6.2.6 Adverse Conditions.

Determine the effects of adverse environmental conditions on test item effectiveness as described in the applicable sections of MTP 4-3-506.

6.2.7 Fire Direction Techniques

- a. During the procedures of paragraphs 6.2.2 through 6.2.6 observe and summarize any instances, or evidence, that current fire direction procedures are not feasible or practical.
- b. Record any deviations from current accepted fire direction procedures used.
- c. Record suggestions for correcting fire direction techniques.

6.2.8 User Reaction

Determine the "user reaction" to the test item during the period of testing as described in the applicable sections of MTP 4-3-504.

6.2.9 Ammunition Functioning Reliability

During the conduct of all firing tests determine the ammunition functioning reliability of the test item and standard item as described in the applicable sections of MTP 4-3-502.

6.2.10 Maintenance Evaluation

During the period of testing determine the maintenance characteristics

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of the test item as described in the applicable sections of MTP 4-3-513.

6.2.11 Human Factors Evaluation

Evaluate the effectiveness of the test item-weapon-personnel relationships during the period of testing as described in the applicable sections of MTP 4-3-515.

6.2.12 Safety Hazards

Evaluate the safety aspects of the test item during the period of testing as described in the applicable sections of MTP 4-3-514.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Preoperation Inspection and Physical Characteristics

Record data as described in the applicable sections of MTP 4-3-500.

6.3.1.2 Personnel

Record the following:

a. For all test personnel:

- 1) Rank
- 2) MOS
- 3) Experience in MOS
- 4) Training time in MOS

b. Adequacy of supplied training literature

6.3.1.3 Weapons

Record the following for each weapon used:

- a. Type
- b. Caliber
- c. Model number
- d. Physical condition

6.3.2 Test Conduct

6.3.2.1 Component Compatibility

Record the following:

- a. Any difficulty encountered in assembling the test item to the components.

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b. Any difficulty encountered in setting the fuze on the test rounds.

6.3.2.2 Accuracy and Precision and Ballistic Match

a. For firing data:

- 1) Record the type, model and caliber of each weapon used
- 2) Record the following for each round fired:
 - a) Projectile used (standard, newly arrived test item, post storage test item, post transportation test item).
 - b) Data collected as described in the applicable section of MTP 3-3-506.

b. Record the following for stored test items as indicated in MTP 4-3-520:

- 1) Storage data
- 2) Inspection data

c. Record the following for transported test items:

- 1) After each 100 miles of travel
 - a) Number of miles of travel
 - b) Vehicle used
 - c) Materiel handling equipment used:
 - (1) Loading the vehicle
 - (2) Unloading the vehicle
 - d) Damage sustained:
 - (1) Loading the vehicle
 - (2) Unloading the vehicle
- 2) At the completion of transportation testing:
 - a) Number of test items rendered unsatisfactory for firing
 - b) Damage sustained

6.3.2.3 Direct Fire Muzzle Action

Record the following for each round fired for each range and elevation:

- a. Target range in meters (50 and 100, 250 and 300, etc.)
- b. Weapon elevation in mils
- c. Round number
- d. Point of functioning (in meters from test weapon)
- e. For all target hits:

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- 1) Number of target hits
- 2) Target location
- 3) Depth of each penetration
- 4) Composition of target material

- f. Details relative to each malfunction
- g. Current meteorological data

6.3.2.4 Direct Fire Time Action

Record the following for each round fired for each condition:

- a. Target range in meters (50 and 100, 2950 and 3000, etc.)
- b. Weapon elevation in mils
- c. Fuze and time setting
- d. Round number
- e. Point of functioning (in meters from test weapon)
- f. For dye marker rounds:
 - 1) Visibility of the dye marker (fair, poor, etc)
 - 2) Point of functioning (in meters from test weapon)
- g. For all target hits:
 - 1) Number of target hits
 - 2) Target location
 - 3) Depth of each penetration
- h. Details relative to each malfunction
- i. Current meteorological data

6.3.2.5 Indirect Fire

Record current meteorological data

6.3.2.5.1 Pyrotechnic Flare Marker -

Record the following for each charge used:

- a. Technique used (single phase, two phase)
- b. Charge number
- c. Range in percent of maximum range
- d. Weapon elevation in mils
- e. Difficulties experienced adjusting the round onto the target
- f. Details relative to each malfunction

6.3.2.5.2 Spotting Round -

Record the following:

- a. Difficulties in adjusting onto target, if any.

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- b. Large or significant dispersion between the spotting round and test round.
- c. Detail relative to each malfunction.
- d. Compatibility of test round and spotting round.

6.3.2.5.3 Transfer Fire -

Record the following:

- a. Significant dispersion errors by the test round in "fire for effect".
- b. Effect of test item in target area.
- c. Details relative to any malfunctions.

6.3.2.6 Adverse Conditions

Record data, collected as described in the applicable sections of MTP 4-3-504.

6.3.2.7 Fire Direction Techniques

Record the following:

- a. Instances where current fire direction procedures are inadequate
- b. Procedures used that varied from accepted fire direction procedures
- c. Suggestions for correcting fire direction procedures

6.3.2.8 User Reaction

Record data, collected as described in the applicable sections of MTP 4-3-504.

6.3.2.9 Ammunition Functioning and Reliability

Record the ammunition functioning reliability for the test item and standard item, collected as described in the applicable sections of MTP 4-3-502.

6.3.2.10 Maintenance Evaluation

Record data, collected as described in the applicable sections of MTP 4-3-513.

6.3.2.11 Human Factors Evaluation

Record data, collected as described in the applicable sections of MTP 5-2-515.

6.3.2.12 Safety Hazards

Record safety data, collected as described in the applicable sections

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of MTP 4-3-514.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained from all subtests covered by applicable referenced MTP's shall be summarized and evaluated according to procedures described in those MTP's. Appropriate charts, graphs and tabulated summaries shall be used to present the data in a clear manner. Special consideration shall be given to any condition or circumstance contributing to any test result.

Calculations shall be performed as specified by the referenced individual MTP's, wherever applicable. All photographs shall be retained and suitably identified along with other illustrative material.

Chart all probable errors in range, deflection and height of burst and compare the probable errors of:

- a. Test item not stored or transported
- b. Test item placed in field storage
- c. Test item transported
- d. Standard item fired for comparison purposes

Prepare diagrams to indicate the hit pattern and lethal effect of:

- a. Muzzle action mode firing
- b. Direct fire time fuze action mode

Summarize the effectiveness of the test item in its various indirect fire missions.

An overall evaluation of the suitability of the test item for use by the Army shall be made, based on the QMR, SDR, TC or other reliable criteria.

Issue a Safety Confirmation, in accordance with USATECOM Regulation 385-6 based on all data collected.

Evaluate the effectiveness of dye markers, when applicable, for determining location of point of functioning.

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